Properly Treat Boiler Water for Efficient, Long-Term Operation

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To ensure a boiler runs properly over the course of its lifetime, treating the water that circulates within the system is mandatory. If the water is not treated properly, the boiler will begin to have problems within the first year, and its useful life will be significantly shortened. Boiler symptoms resulting from untreated water include overheating, failure to produce hot water or steam, a drop in the boiler flow rate and an overall loss of efficiency.

Recommended Guidelines
Water treatment recommendations vary depending on the operating pressure of the boiler, the application (steam or hot water), and other parameters. General guidelines to prevent corrosion and scaling in low pressure boilers are as follows:

Total Hardness	**1 PPM Maximum**
Total Alkalinity	**600 PPM Maximum**
Total Silica	**150 PPM Maximum**
Iron Content	**0.1 PPM Maximum**
pH	**8.5 – 10.5**
Total Dissolved Solids	**2,200 to 2,500 PPM**
Oxygen Content	**0 PPM**
Carbon Dioxide	**0 PPM**

(Source: Cleaver-Brooks, Inc.)

To protect the integrity of the boiler and ensure it continues to produce good steam quality, it is important to properly treat the feedwater, or the water going into the boiler. A water treatment system will:

- prevent deposits on boiler surfaces that weaken metal and cause heat transfer losses,
- prevent oxygen corrosion, which causes pitting of boiler tubes and rust deposits,
- prevent low pH (below 9 causes corrosion), and
- prevent steam condensate contamination.

Harmful Elements in Untreated Water
Untreated water, even water coming from a municipal water utility, can contain dissolved salts, which form scale on the heat transfer surfaces as the water is heated. The main disadvantage of this deposited scale is that it drastically reduces the heat transfer capability of the boiler, which leads to overheating, tube failure and efficiency loss. Scale also reduces the flow area, which increases the pressure drop in boiler tubes and piping, resulting in low steam volume and potential downstream equipment failure.

Boiler feedwater also contains dissolved gases, such as carbon dioxide and oxygen, that react in a boiler and lead to corrosion of the boiler internals and the piping system. If these gases are not extracted from the water supply before entering the boiler, the corrosion will eventually eat through boiler tubes and cause leaks and equipment failure.

Boiler feedwater also contains metal salts such as chlorides, magnesium, sulphur and calcium bicarbonates. All of these salts combine to form what is known as the "hardness" of water, with calcium and magnesium contributing the most to water hardness. If deposits of calcium and magnesium are not removed from boiler feedwater, they will coat heating surfaces and eventually plug pipes and boiler tubes. Over time, the flow through a 1½" boiler tube may be restricted to only ½" due to blockage caused by calcium and magnesium deposits or scale.

Untreated water can lead to corrosion of boiler internals and piping.

Water Treatment Program

There are mechanical equipment and chemical solutions available to treat boiler feedwater easily and cost effectively. The best solution is to use a combination of both approaches. Treating boiler feedwater mechanically with the proper water treatment equipment can remove 90 – 97 percent of the impurities. The remaining impurities can be easily removed by chemical treatment. Using a chemical-only approach is expensive due to the cost of the chemicals, and it also can be environmentally hazardous since the facility will be flushing excess chemicals into its waste stream. In addition, using a chemical-only approach is the most time consuming and requires constant monitoring to ensure proper treatment is always in place.

The best approach for most applications is to install water treatment equipment to eliminate the majority of the impurities, and then add a chemical feed system to inject the recommended chemicals to remove the remainder of the impurities. The proper selection usually can be reached by consulting the boiler manufacturer and a chemical water treatment expert.

Perhaps the most important piece of water treatment equipment is a water softener, which ensures good boiler water quality. Water softeners use a process called ion exchange to remove calcium and magnesium from the water. The hardness minerals are replaced with a highly soluble sodium or potassium ion that will not cause scale buildup, helping a boiler maintain efficiency throughout its life.

Water softeners remove harmful minerals that can cause scale buildup in your boiler.

By preventing scale buildup, a water softener also reduces a boiler's fuel consumption. A 1/16" thick layer of hardness scale can reduce heat transfer by about 12 percent, which is directly proportional to the increased amount of fuel required to compensate for the loss. The recommended hardness of boiler feedwater is less than 1 ppm, so a water softener is required for nearly all boilers.

If the boiler feedwater contains a high level of bicarbonate alkalinity and sulfates, a dealkalizer is recommended. Alkalinity is a measure of the capacity of water to neutralize strong acids such as carbonic acid, which is carbon dioxide dissolved in water. The condensate return system in a steam system is the most common way carbonic acid can get into the system. A dealkalizer keeps boiler and process equipment scale free and also reduces the level

of corrosive condensate. This prevents scaling and reduces potential steel corrosion within the steam system.

Another piece of equipment commonly used for boiler water treatment is a deaerator, which reduces oxygen and carbon dioxide to minute levels. The deaerator uses a mechanical scrubbing method to eliminate the harmful gases from a feedwater supply. A deaerator frequently is used in larger facilities and in facilities that run multiple boilers. The deaerator removes almost all harmful gases, and the remaining gases are removed by chemical means. The initial investment in a deaerator is easily recovered by an extended boiler and steam equipment lifecycle, lower maintenance costs, and reduced downtime. The proper deaerator for a particular boiler application can be specified by the boiler manufacturer.

Figure 1 illustrates that by slowly heating incoming make-up water from 50°F to 180°F, the oxygen levels in the water are reduced from 8 ppm to 2 ppm.

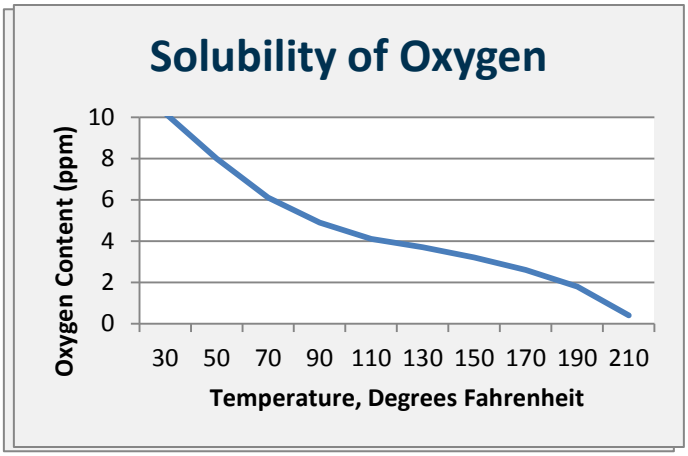

Figure 1

A chemical feed system is typically required to remove the last 3 – 10 percent of impurities from boiler feedwater. Working with a chemical water treatment company makes the last stage of treating boiler feedwater easy. Premixed chemicals in 30- to 100-gallon plastic drums with a chemical feed pump remove the remainder of harmful impurities from the boiler feedwater. This combination of mechanical equipment and chemical treatment will fully protect the investment in a boiler and steam system. It also assures the lowest chemical use for "greener" manufacturing or other end-user operation.

This water treatment approach is appropriate for low pressure steam and hot water boilers. High pressure steam applications will require more stringent water quality control measures.

Know Your Water Source

When shopping for water treatment equipment, it is important to know the local water chemistry in order to understand what problems have to be treated and how to size the equipment. This information is available in the water analysis for the raw water supply.

Most end-user facilities are located in municipal areas, so the water quality report is available online via the local water utility. If the water report is not available online, contact the local utility to obtain a copy. As an alternative, a facility can hire a local lab to conduct a water analysis. This water analysis will help assure that the right water treatment system is selected and installed to meet the guidelines above.

Don't Overlook Daily Testing

Testing the water treatment equipment and chemical effectiveness is a commonly overlooked part of the boiler operation process. In order to ensure proper system chemistry and verify that the water treatment equipment is doing its part, daily testing and recording in a chemical log book is recommended. Most qualified chemical companies can supply the proper testing equipment, written procedures and log books to help perform the testing and will assist as needed. The most important part

of the treatment program is making the necessary dosing adjustments to keep the chemistry in line. Just recording a number that is out of the desired range does nothing to protect the equipment. Work with the chemical supplier to develop a troubleshooting guide to know how to adjust to correct problems before they damage the equipment. Highly corrosive conditions, for even a short period of time, can do a lot of damage to a system and the boiler equipment.

Installation of a properly engineered water treatment system, along with chemical treatment will protect the boiler and steam or hot water system. A water treatment program is essential to protect a facility's boiler investment. Properly treated water provides efficient equipment operation, increases boiler life expectancy, reduces fuel use, optimizes water use and reduces waste. It will also provide considerable savings on maintenance and labor. Installing properly engineered water treatment equipment to treat boiler feedwater will also save a facility money on chemicals. This dual approach will provide a quick payback for the water treatment equipment investment.

To locate a Representative, visit cleaverbrooks.com/reps or call 800-250-5883.